

Claims

1. An optical amplifier module containing at least one optical amplifier, said module comprising:
 - an internal housing having an outer dimension substantially equal to an outer dimension of an internal fiber splice housing of an undersea optical fiber cable joint, said internal housing including:
 - a pair of opposing end faces each having a retaining element for retaining the internal housing within an outer housing of said undersea optical fiber cable joint;
 - a sidewall interconnecting said opposing end faces and extending between said opposing end faces in a longitudinal direction, said sidewall being formed from a thermally conductive material and including a receptacle portion having a plurality of thru-holes each being sized to receive a passive optical component employed in an optical amplifier;
 - at least one circuit board on which resides at least one voltage dropping element for conveying voltage from the conductor to electronics also residing on the circuit board and associated with the optical amplifier; and
 - an isolated electrical path for providing electrical power received from a conductor in at least one optical fiber cable to the at least one circuit board, wherein said voltage dropping element is in thermal communication with said sidewall.
2. The optical amplifier module of claim 1 further comprising at least one optical pump source in thermal contact with one of the end faces.
3. The optical amplifier module of claim 2 wherein said end faces each include at least one inwardly extending boss, said at least one optical pump source residing on one of the inwardly extending bosses.

4. The optical amplifier module of claim 1 wherein a first side of the circuit board resides on a surface extending through the sidewall and further comprising a thermally conductive pad mounted to the first side of the circuit board and providing a thermally conductive path between the voltage dropping element and the sidewall.

5. The optical amplifier module of claim 4 wherein the voltage dropping element is mounted to the thermally conductive pad.

6. The optical amplifier module of claim 1 wherein said undersea optical fiber cable joint includes a pair of cable termination units in which end portions of optical fiber cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

7. The optical amplifier module of claim 6 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

8. The optical amplifier module of claim 7 wherein said isolated electrical path includes a power conductor located within the circuit board that is in electrical contact with one of the retaining elements.

9. The optical amplifier module of claim 1 wherein said voltage dropping element is a zener diode.

10. The optical amplifier module of claim 8 wherein said at least one circuit board comprises a pair of circuit boards, and wherein said isolated electrical path further comprises at least one electrically conductive pin electrically connecting the power conductors of the pair of circuit boards.

11. The optical amplifier module of claim 1 wherein said plurality of thru-

holes laterally extend through said receptacle portion of the sidewall in the longitudinal direction.

12. The optical amplifier module of claim 1 wherein said internal housing has a generally cylindrical shape, said receptacle portion of the sidewall having a curvature that defines a diameter of the cylindrical shape.

13. The optical amplifier module of claim 1 wherein the undersea optical fiber cable joint is a universal joint for jointing optical cables having different configurations.

14. The optical amplifier module of claim 1 wherein said retaining elements each include a flange through which at least one optical fiber extending from the end portion of one of the optical cables extends into the internal housing.

15. The optical amplifier module of claim 1 further comprising an optical fiber storage area located within said internal housing.

16. The optical amplifier module of claim 15 wherein said optical fiber storage area includes at least one optical fiber spool around which optical fiber can be wound.

17. The optical amplifier module of claim 1 wherein said internal housing is formed from a pair of half units that each include one of the retaining elements.

18. The optical amplifier module of claim 10 wherein said internal housing is formed from a pair of half units that each include one of the retaining elements.

19. The optical amplifier module of claim 18 wherein each circuit board is located in a different one of the half units.

20. The optical amplifier module of claim 1 wherein said sidewall includes a

pair of ribbed members extending longitudinally from the receptacle portion of the sidewall, said ribbed members each having a tension rod thru-hole extending laterally therethrough in the longitudinal direction for supporting a tension rod employed by the undersea optical fiber cable joint.

21. The optical amplifier module of claim 1 wherein the outer dimension of the internal housing is less than about 15 cm x 50 cm.

22. The optical amplifier module of claim 1 wherein the outer dimension of the internal housing is about 7.5 cm x 15 cm.

23. The optical amplifier module of claim 1 wherein said thermally conductive material of which the sidewall is formed is aluminum.

24. In an external, hermetically sealed outer housing of an undersea optical fiber cable joint, an optical amplifier module comprising:

a protective sleeve;

an internal housing located in said protective sleeve, said internal housing including:

a pair of opposing end faces each having a retaining element for retaining the internal housing within an outer housing of said undersea optical fiber cable joint; and

a sidewall interconnecting said opposing end faces and extending between said opposing end faces in a longitudinal direction, said sidewall being formed from a thermally conductive material and including a receptacle portion having a plurality of thru-holes each being sized to receive a passive optical component employed in an optical amplifier;

at least one circuit board on which resides at least one voltage dropping element for conveying voltage from the conductor to electronics also residing on the circuit board and associated with the optical amplifier; and

an isolated electrical path for providing electrical power received from a conductor in at least one optical fiber cable to the at least one circuit board, wherein said voltage dropping element is in thermal communication with said sidewall.

25. The optical amplifier module of claim 24 further comprising at least one optical pump source in thermal contact with one of the end faces.

26. The optical amplifier module of claim 25 wherein said end faces each include at least one inwardly extending boss, said at least one optical pump source residing on one of the inwardly extending bosses.

27. The optical amplifier module of claim 24 wherein a first side of the circuit board resides on a surface extending through the sidewall and further comprising a thermally conductive pad mounted to the first side of the circuit board and providing a thermally conductive path between the voltage dropping element and the sidewall.

28. The optical amplifier module of claim 27 wherein the voltage dropping element is mounted to the thermally conductive pad.

29. The optical amplifier module of claim 24 wherein said undersea optical fiber cable joint includes a pair of cable termination units in which end portions of optical fiber cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

30. The optical amplifier module of claim 29 wherein said conductor of each of the optical fiber cables to be jointed are in electrical contact with one of the retaining elements.

31. The optical amplifier module of claim 30 wherein said isolated electrical

path includes a power conductor located within the circuit board that is in electrical contact with one of the retaining elements.

32. The optical amplifier module of claim 24 wherein said voltage dropping element is a zener diode.

33. The optical amplifier module of claim 31 wherein said at least one circuit board comprises a pair of circuit boards, and wherein said isolated electrical path further comprises at least one electrically conductive pin electrically connecting the power conductors of the pair of circuit boards.

34. The optical amplifier module of claim 24 wherein said plurality of thru-holes laterally extend through said receptacle portion of the sidewall in the longitudinal direction.

35. The optical amplifier module of claim 24 wherein said internal housing has a generally cylindrical shape, said receptacle portion of the sidewall having a curvature that defines a diameter of the cylindrical shape.

36. The optical amplifier module of claim 24 wherein the undersea optical fiber cable joint is a universal joint for jointing optical cables having different configurations.

37. The optical amplifier module of claim 36 wherein said universal joint includes a pair of cable termination units in which end portion of the optical cables to be jointed are respectively retained, said retaining elements each being connectable to one of the cable termination units.

38. The optical amplifier module of claim 37 wherein said retaining elements each include a flange through which at least one optical fiber extending from the end portion of one of the optical cables extends into the internal housing.

39. The optical amplifier module of claim 24 further comprising an optical fiber storage area located within said internal housing.

40. The optical amplifier module of claim 37 wherein said optical fiber storage area includes at least one optical fiber spool around which optical fiber can be wound.

41. The optical amplifier module of claim 24 wherein said internal housing is formed from a pair of half units each including at least one of the retaining elements.

42. The optical amplifier module of claim 33 wherein said internal housing is formed from a pair of half units each including at least one of the retaining elements.

43. The optical amplifier module of claim 42 wherein each circuit board is located in a different one of the half units.

44. The optical amplifier module of claim 24 wherein said sidewall includes a pair of ribbed members extending longitudinally from the receptacle portion of the sidewall, said ribbed members each having a tension rod thru-hole extending laterally therethrough in the longitudinal direction for supporting a tension rod employed by the undersea optical fiber cable joint.

44. The optical amplifier module of claim 24 wherein the outer dimension of the internal housing is less than about 15 cm x 50 cm.

45. The optical amplifier module of claim 24 wherein the outer dimension of the internal housing is about 7.5 cm x 15 cm.